

CLAIMS

1. A method of forming a capacitor, comprising:
 - depositing a container forming layer over a substrate;
 - depositing a carbon containing masking layer over the container forming layer;
 - patterning the carbon containing masking layer to comprise a plurality of container openings therein having minimum feature dimensions of less than or equal to 0.20 micron, the container openings respectively having at least three peripheral corner areas which are each rounded;
 - plasma etching the container forming layer through the masking layer openings using conditions effective to both a) etch the masking layer to modify shape of the masking layer openings by at least reducing degree of roundness of the at least three corners in the masking layer, and b) form container openings in the container forming layer of the modified shapes; and
 - forming capacitors comprising container shapes using the container openings in the container forming layer.

2. The method of claim 1 wherein the etching is effective to reducing the degree of roundness effective to square said corner regions when viewed at a magnification level having a field of view in which all of a single container opening is viewable.

3. The method of claim 1 wherein the container openings have at least four peripheral corner regions, and all of which have reduced degree of roundness from the etching.

4. The method of claim 1 wherein the container openings have only four peripheral corner regions, and all of which have reduced degree of roundness from the etching.

5. The method of claim 1 wherein the container openings have only three peripheral corner regions, and all of which have reduced degree of roundness from the etching.

6. The method of claim 1 wherein the container openings have at least six peripheral corner regions, and all of which have reduced degree of roundness from the etching.

7. The method of claim 1 wherein the masking layer comprises photoresist.

8. The method of claim 1 wherein the masking layer comprises amorphous carbon.

9. The method of claim 1 wherein the patterning comprises photolithography and solvent etch.

10. The method of claim 1 wherein the container openings are patterned to have minimum feature dimensions of less than 0.15 micron.

11. The method of claim 1 wherein the container openings are patterned to have minimum feature dimensions of less than 0.10 micron.

12. The method of claim 1 comprising fabricating the capacitor as part of DRAM circuitry.

13. The method of claim 1 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed.

14. The method of claim 1 wherein the conditions comprise plasma etching using a total applied power of at least 10W/cm^2 of substrate area being processed.

15. The method of claim 1 wherein the conditions comprise plasma etching using a substrate temperature of at least 40°C.

16. The method of claim 1 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed, and using a substrate temperature of at least 40°C .

17. The method of claim 1 wherein the conditions comprise a fluorocarbon comprising etching chemistry.

18. The method of claim 1 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed, using a substrate temperature of at least 40°C , and a fluorocarbon comprising etching chemistry.

19. The method of claim 1 wherein the conditions comprise plasma etching in a capacitively coupled, multi frequency plasma etcher.

20. The method of claim 19 wherein multiple frequencies are applied to a wafer chuck upon which the substrate rests during etching.

21. The method of claim 20 wherein the plasma etching uses a total applied power of at least 7W/cm^2 of substrate area being processed to the wafer chuck, uses a substrate temperature of at least 40°C , and a fluorocarbon comprising etching chemistry.

22. The method of claim 19 wherein one frequency is applied to a wafer chuck upon which the substrate rests during etching and another frequency is applied to an electrode spaced from the substrate.

23. A method of forming a capacitor, comprising:
depositing a container forming layer over a substrate;
depositing a carbon containing masking layer over the container forming layer;

patterning the carbon containing masking layer to comprise a plurality of generally racetrack shaped container openings therein having minimum feature dimensions of less than or equal to 0.20 micron;

plasma etching the container forming layer through the masking layer openings using conditions effective to both a) etch the masking layer to modify shape of the masking layer openings into rectangles, and b) form container openings in the container forming layer of the modified rectangular shapes; and

forming capacitors comprising container shapes using the container openings in the container forming layer.

24. The method of claim 23 wherein the masking layer comprises photoresist.

25. The method of claim 23 wherein the masking layer comprises amorphous carbon.

26. The method of claim 23 wherein the container openings are patterned to have minimum feature dimensions of less than 0.15 micron.

27. The method of claim 23 wherein the container openings are patterned to have minimum feature dimensions of less than 0.10 micron.

28. The method of claim 23 comprising fabricating the capacitor as part of DRAM circuitry.

29. The method of claim 23 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed.

30. The method of claim 23 wherein the conditions comprise plasma etching using a total applied power of at least 10W/cm^2 of substrate area being processed.

31. The method of claim 23 wherein the conditions comprise plasma etching using a substrate temperature of at least 40°C .

32. The method of claim 23 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed, and using a substrate temperature of at least 40°C .

33. The method of claim 23 wherein the conditions comprise a fluorocarbon comprising etching chemistry.

34. The method of claim 23 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed, using a substrate temperature of at least 40°C , and a fluorocarbon comprising etching chemistry.

35. The method of claim 23 wherein the conditions comprise plasma etching in a capacitively coupled, multi frequency plasma etcher.

36. The method of claim 35 wherein multiple frequencies are applied to a wafer chuck upon which the substrate rests during etching.

37. The method of claim 36 wherein the plasma etching uses a total applied power of at least 7W/cm^2 of substrate area being processed to the wafer chuck, uses a substrate temperature of at least 40°C , and a fluorocarbon comprising etching chemistry.

38. The method of claim 35 wherein one frequency is applied to a wafer chuck upon which the substrate rests during etching and another frequency is applied to an electrode spaced from the substrate.

39. A method of forming a capacitor, comprising:
depositing a container forming layer over a substrate;
depositing a carbon containing masking layer over the container forming layer;

patterning the carbon containing masking layer to comprise a plurality of container openings therein having minimum feature dimensions of less than or equal to 0.20 micron, the respective container openings including a plurality of straight line segments of at least 2 nanometers long;

plasma etching the container forming layer through the masking layer openings using conditions effective to both a) etch the masking layer to modify shape of the masking layer openings to increase the number of straight line segments of at least 2 nanometers long, and b) form container openings in the container forming layer of the modified shapes; and

forming capacitors comprising container shapes using the container openings in the container forming layer.

40. The method of claim 39 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed.

41. The method of claim 39 wherein the conditions comprise plasma etching using a total applied power of at least 10W/cm^2 of substrate area being processed.

42. The method of claim 39 wherein the conditions comprise plasma etching using a substrate temperature of at least 40°C .

43. The method of claim 39 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed, and using a substrate temperature of at least 40°C .

44. The method of claim 39 wherein the conditions comprise a fluorocarbon comprising etching chemistry.

45. The method of claim 39 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed, using a substrate temperature of at least 40°C , and a fluorocarbon comprising etching chemistry.

46. The method of claim 39 wherein the conditions comprise plasma etching in a capacitively coupled, multi frequency plasma etcher.

47. The method of claim 46 wherein multiple frequencies are applied to a wafer chuck upon which the substrate rests during etching.

48. The method of claim 47 wherein the plasma etching uses a total applied power of at least 7W/cm^2 of substrate area being processed to the wafer chuck, uses a substrate temperature of at least 40°C , and a fluorocarbon comprising etching chemistry.

49. The method of claim 46 wherein one frequency is applied to a wafer chuck upon which the substrate rests during etching and another frequency is applied to an electrode spaced from the substrate.

50. A method of forming a capacitor, comprising:

depositing a container forming layer over a substrate;

depositing a carbon containing masking layer over the container forming layer;

patterning the carbon containing masking layer to comprise a plurality of container openings therein having minimum feature dimensions of less than or equal to 0.20 micron, the respective container openings including no more than two straight line segments of at least 2 nanometers long;

plasma etching the container forming layer through the masking layer openings using conditions effective to both a) etch the masking layer to modify shape of the masking layer openings to include at least four straight line segments of at least 2 nanometers long, the at least four straight line segments having total added length which is more than 50% of the perimeter of the respective modified shapes, and b) form container openings in the container forming layer of the modified shapes; and

forming capacitors comprising container shapes using the container openings in the container forming layer.

51. The method of claim 50 wherein said total added length is more than 60% of the perimeter of the respective modified shapes.

52. The method of claim 50 wherein said total added length is more than 70% of the perimeter of the respective modified shapes.

53. The method of claim 50 wherein said total added length is more than 80% of the perimeter of the respective modified shapes.

54. The method of claim 50 wherein said total added length is more than 90% of the perimeter of the respective modified shapes.

55. The method of claim 50 wherein the modified shape has said straight line segments numbering only four.

56. The method of claim 50 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed.

57. The method of claim 50 wherein the conditions comprise plasma etching using a total applied power of at least 10W/cm^2 of substrate area being processed.

58. The method of claim 50 wherein the conditions comprise plasma etching using a substrate temperature of at least 40°C .

59. The method of claim 50 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed, and using a substrate chuck temperature of at least 40°C .

60. The method of claim 50 wherein the conditions comprise a fluorocarbon comprising etching chemistry.

61. The method of claim 50 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed, using a substrate temperature of at least 40°C , and a fluorocarbon comprising etching chemistry.

62. The method of claim 50 wherein the conditions comprise plasma etching in a capacitively coupled, multi frequency plasma etcher.

63. The method of claim 62 wherein multiple frequencies are applied to a wafer chuck upon which the substrate rests during etching.

64. The method of claim 63 wherein the plasma etching uses a total applied power of at least 7W/cm^2 of substrate area being processed to the wafer chuck, uses a substrate temperature of at least 40°C , and a fluorocarbon comprising etching chemistry.

65. The method of claim 62 wherein one frequency is applied to a wafer chuck upon which the substrate rests during etching and another frequency is applied to an electrode spaced from the substrate.

66. A method of forming a capacitor, comprising:
depositing a container forming layer over a substrate;
depositing a carbon containing masking layer over the container forming layer;

patterning the carbon containing masking layer to comprise a plurality of circular shaped container openings therein having minimum diameter of less than or equal to 0.20 micron;

plasma etching the container forming layer through the masking layer openings using conditions effective to both a) etch the masking layer to modify shape of the masking layer openings from circular to having at least four straight line segments of at least 2 nanometers long, and b) form container openings in the container forming layer of the modified shapes; and

forming capacitors comprising container shapes using the container openings in the container forming layer.

67. The method of claim 66 wherein the plasma etching forms the modified shapes to be squares.

68. The method of claim 66 wherein the plasma etching forms the modified shapes to be hexagons.

69. The method of claim 66 wherein the patterning comprises photolithography and solvent etch.

70. The method of claim 66 wherein the container openings are patterned to have minimum feature dimensions of less than 0.15 micron.

71. The method of claim 66 comprising fabricating the capacitor as part of DRAM circuitry.

72. The method of claim 66 wherein the conditions comprise plasma etching using a total applied power of at least 7W/cm^2 of substrate area being processed.

73. The method of claim 66 wherein the conditions comprise plasma etching using a total applied power of at least 10W/cm^2 of substrate area being processed.

74. The method of claim 66 wherein the conditions comprise plasma etching using a substrate temperature of at least 40°C .

75. The method of claim 66 wherein the conditions comprise plasma etching using a total applied power of at least $7W/cm^2$ of substrate area being processed, and using a substrate temperature of at least $40^{\circ}C$.

76. The method of claim 66 wherein the conditions comprise a fluorocarbon comprising etching chemistry.

77. The method of claim 66 wherein the conditions comprise plasma etching using a total applied power of at least $7W/cm^2$ of substrate area being processed, using a substrate temperature of at least $40^{\circ}C$, and a fluorocarbon comprising etching chemistry.

78. The method of claim 66 wherein the conditions comprise plasma etching in a capacitively coupled, multi frequency plasma etcher.

79. The method of claim 78 wherein multiple frequencies are applied to a wafer chuck upon which the substrate rests during etching.

80. The method of claim 79 wherein the plasma etching uses a total applied power of at least $7W/cm^2$ of substrate area being processed to the wafer chuck, uses a substrate temperature of at least $40^{\circ}C$, and a fluorocarbon comprising etching chemistry.

81. The method of claim 78 wherein one frequency is applied to a wafer chuck upon which the substrate rests during etching and another frequency is applied to an electrode spaced from the substrate.